

SPECIFICATION

3000 V DC 5400 RAIL HP ELECTRIC LOCOMOTIVE

SPECIFICATION NO. 5002A

NOVEMBER 1969

GENERAL

The electric locomotive covered by this specification is designed to operate on 56-1/2 inch gage track from 3000-volt direct-current power supplied through an overhead contact wire. It is equipped with six GE-750 motors geared to the driving axles.

The superstructure consists of an operating cab at the No. 1 end and an equipment cab.

Materials

All materials are in accordance with standard material specifications of the General Electric Company. Materials and locomotive specifications are subject to change without notice.

Testing

All component parts of the locomotive are given standard commercial tests before assembly on the locomotive.

Each complete locomotive is tested as follows:

- (a) Inspection of electrical and mechanical parts and checking of clearance dimensions.
- (b) Adjustment and operation of air brake equipment.
- (c) Operation of control equipment.
- (d) Measurement of accelerating resistors.
- (e) Operation of auxiliary electrical equipment.
- (f) Calibration of meters and gages.
- (g) High potential tests on individual parts and on assembled locomotive in accordance with I.E.E.E. standards and General Electric Company's standard practice.
- (h) The complete locomotive will be track-tested at the builder's factory.

Painting

Interior - Gray.

Underframe and Running Gear - Black.

Exterior - Color and design as specified by the customer.

SUMMARY

Weights

Total Locomotive (Fully Loaded) ----- 390,000 lb
 Per driving axle (Fully Loaded) ----- 65,000 lb
 Locomotive total weight subject to manufacturing tolerance of
+2%, individual axle loads are subject to an additional
 tolerance of +1% for unbalance.

Dimensions

Track Gage ----- 56-1/2 in.
 Length Over End Frames ----- 56 ft. 7 in.
 Height Over Cab ----- 14 ft. 5-3/4 in.
 Pantograph Locked Down ----- 14 ft. 9-3/4 in.
 Width Overall ----- 10 ft. 1 in.
 Wheel Diameter ----- 48 in.
 Coupler Height ----- 34-1/2 in.
 Minimum Radius of Curvature, Locomotive Alone ----- 279 ft.
 Locomotive Outline ----- 41R961146

Major Equipment

Traction Motors ----- Six GE-750
 Motor-Generator Sets ----- Two GMG-152A1
 Control (75 Volt) ----- Single end, multiple unit
 Equipment Blowers ----- Two, centrifugal type
 Compressors ----- Two WABCO 3CDC 120 CMF, motor driven
 Brake Schedule ----- 26L
 Pantograph ----- One, air controlled, spring operated
 Accelerating Resistors ----- Type 17EWF

Ratings

The traction motors will have the following ratings (Class H insulation):

| <u>Full Field</u> | <u>Amperes Per Motor</u> | <u>Motor Term Volts</u> |
|-------------------|----------------------------------|---------------------------------|
| Continuous | 480 | 1500 |
| One Hour* | 520 | 1500 |
| Continuous | 480 | 1350 |
| One Hour* | 520 | 1350 |

Approximate Locomotive Operating Data at 3000 Volts

| <u>Total Traction Motor Amperes Per Locomotive</u> | <u>Motor Combina- tions</u> | <u>Field Strength</u> | <u>Speed MPH</u> | <u>Locomotive Continuous Tractive Effort</u> |
|--|-------------------------------------|---------------------------|----------------------|--|
| 1440 | 2S3P | FS-1 | 24. | 85,500 |
| 1440 | 2S3P | FS-2 | 27.9 | 73,200 |
| 1440 | 2S3P | FS-3 | 30.9 | 66,000 |
| 960 | 3S2P | FS-1 | 15.2 | 86,000 |
| 960 | 3S2P | FS-2 | 18.7 | 73,500 |
| 960 | 3S2P | FS-3 | 20. | 66,000 |
| 480 | 6S | FS-1 | 7.0 | 86,000 |
| 480 | 6S | FS-2 | 8.9 | 73,500 |
| 480 | 6S | FS-3 | 9.3 | 66,000 |

| | |
|--|-----------|
| Maximum permissible locomotive speed ----- | 69.6 |
| Speed Tractive Effort Characteristic ----- | 41H138413 |
| Regenerative Braking Characteristics (when supplied) ----- | 41H135844 |
| Single Motor Characteristic Curves ----- | 41H135845 |
| Traction Motor Wheel Diameter ----- | 48 Inches |
| Traction Motor Gear Ratio ----- | 80/21 |

The design of the motors, M-G sets, and control is based on a maximum trolley potential of 3600 volts and a minimum trolley potential of 2100 volts.

SUPERSTRUCTURE

The welded steel superstructure consists of an operator's cab at the front end of the locomotive and a full-width equipment cab.

Underframe

The locomotive underframe consists of two steel main sills with end plates, deck plates and transverse steel bolsters, securely welded.

The replaceable center and side-bearing wear plates are of wear-resistant steel.

Operator's Cab

The sides and roof of the operator's cab are insulated against heat and sound. The floor, raised above the platform, is covered with high density laminated hard board.

The operator's cab has safety glass windows in the front and each side. Windows on each side of the cab have sliding sash, equipped with latches. All other windows are fixed and mounted in rubber self-sealing sash.

Doors at each side of the operator's cab provide access. The doors have windows, weather stripping and locks. Two doors are also provided for access to the equipment cab from the operator's cab.

Right-hand control is provided in the operator's cab.

Aisle

Aisles are provided for access to equipment compartments. Walkways and steps have handrails and non-skid treads.

Equipment Cab

Removable portions of the equipment cab permit removal and installation of major equipment. All hatches and cabs are sufficiently rain-tight to protect electrical equipment likely to be damaged by excess moisture.

Pilots

A pilot, with an end step fastened to each side, is bolted to each end plate.

Couplers and Draft Gear

Type E couplers and type M-381 draft gear with alignment control are provided.

Lifting and Jacking

Four combination jacking pads and lifting lugs are provided on the underframe.

Sand Boxes

Sand boxes have a combined capacity of 48 cu ft. They are of welded steel construction, arranged for outside filling, and equipped with weather-tight covers.

RUNNING GEAR

The running gear of the locomotive consists of two, three-axle, lateral motion swivel trucks.

Center plate load is distributed by the "floating bolster" to four rubber mounts which rest on the truck frame and provide controlled lateral motion. The truck frame is supported by alloy steel coil springs.

The truck frame consists of cast steel side frames joined integrally with structural steel shapes by electric welding.

Wheels

Solid multiple-wear, rolled-steel wheels of 48 inch diameter have standard AAR tread and flange contour.

Axles

Axles are forged carbon steel, conforming to AAR material specifications.

Journal Boxes

Journal boxes are equipped with grease-lubricated roller bearings.

Journal box guides are lined with renewable steel wear-resistant plates. Ground brushes are mounted at one end of each axle on the journal box.

Pedestal Guides

Steel wear plates are bolted to pedestal guides.

Center Plates

Center plates are equipped with renewable wear-resistant liners and are arranged for lubrication.

Side Bearings

Side bearings with renewable wear-resistant steel wear plates are provided.

Safety Hooks

Safety hooks are provided to prevent slewing and to permit the trucks to be lifted with the superstructure.

ELECTRICAL EQUIPMENT

Traction Motors

Six General Electric GE-750 direct-current, series-field, 1500-volt traction motors insulated for 3000 volts are furnished. These motors have box frames with removable frameheads and are arranged for suspension by two bearings on the driving axle and one resilient nose support on the truck transom. The sleeve-type suspension bearings are arranged for felt wick lubrication. The cylindrical roller, antifriction armature bearings are grease lubricated.

Each motor is equipped with one gear case, one pinion and one gear.

| | |
|---|-----------|
| Gear ratio ----- | 80/21 |
| Clearance under gear case (all parts new) ----- | 5-1/2 in. |

Control Equipment

The locomotive is equipped with General Electric railway type single-end multiple-unit electro-pneumatic control.

Steps and combination of motors in motoring are as follows:

Six motors in series -

- 15 - Resistance steps
- 1 - Running step (full series)

Three motors in series, two groups in parallel -

- 10 - Resistance steps
- 1 - Running step (full series-parallel full field)

Two motors in series, three groups in parallel -

- 8 - Resistance steps
- 1 - Running step (full parallel - full field)

In addition to the above full-field running positions, two extra steps of reduced field operation are provided for each of the three running steps.

If regenerative braking is supplied, 15 steps on the braking cylinder of the controller may be used in any of the three motor combinations after selecting the proper motor combination by means of the main handle.

Each master controller has three operating handles. The main handle controls the contactors shorting out the accelerating resistances, the combinations of the motors, and is also used in regenerative braking to set up the motor combination. The handle just above the main handle has 15 steps for regenerative braking and also has two additional notches to provide field shunting.

A reverse handle controls the direction of motion of the locomotive. The handles are mechanically interlocked to prevent improper manipulation. The controller governs the operation of the propulsion control equipment by means of electrical control circuits.

Main Circuit Control

The reverser, braking switch and the series - series parallel - parallel transfer switch are multiple-contact devices operated by air cylinders controlled by magnet valves. The traction motor and resistor contactors are individually electro-pneumatically operated and controlled by contacts on the master controller.

The main switch, which carries the current for all of the traction motors, is of the knife blade type and is operated manually by means of a pole with switch hook when not carrying current. It is not intended to be opened under load.

Multiple-unit operation for three similar units is provided and arranged to cover complete control of motoring, regenerative braking, independent air brake, sanding and headlights.

A high-speed circuit breaker is provided to protect the traction motor circuits against short circuits. Three overload relays are connected to sense motor currents. These relays provide overload protection and when tripped cause the high-speed breaker to open.

SPEED TRACTIVE EFFORT CURVE

For Electric Locomotives

6 - GE-750 1500/3000 Volt Traction Motors

80/21 Gear Ratio, 48" Wheel Diameter

Based on 3000 Volt Line Potential

GENERAL ELECTRIC CO.

M.A. HAYATH

41H138413

LOCOMOTIVE TRACTIVE EFFORT - POUNDS

120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0

SPEED - MPH

0 10 20 30 40 50 60 70
0 100 200 300 400 500 600 700

MOTOR AMPERES

TE(FS-1)
TE(FS-2)
TE(FS-3)

Speed 2S3P (FS-3)
Speed 2S3P (FS-2)
Speed 2S3P (FS-1)
3S2P (FS-1)
3S2P (FS-2)
3S2P (FS-1)
6S (FS-2)
6S (FS-1)

PEZ-52-201-201

8/11/69

41H138413

EN-52-3 (Rev. 5-61)

LOCOMOTIVE REGENERATIVE BRAKING CURVES

Equipment:
6 - GE-750-A1 1500/3000 Volt
Railway Motors
80/21 Gear Ratio
48" Wheel Diameter

Based on 3000 Volt Line Potential

GENERAL ELECTRIC COMPANY (RV)
R. LAMBORN (EPP)

Shaded areas indicate continuous
braking zones.
Unshaded enclosed areas indicate
short time braking zones.

BRKING EFFORT (LBS)

100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0

0 10 20 30 40 50 60 70 80
SPEED (MPH)

Nov. 4, 1910 m.f.

41H135844

41H135844



A wheel-slip detecting circuit, which operates by comparing motor voltages, is provided with an indicating light to warn of wheel slip during motoring.

A no-voltage relay prevents voltage application to the traction motors unless the controller is returned to the OFF position. An auxiliary relay provides for proper reapplication of the auxiliary rotating equipment to the trolley potential.

Safety Interlocking

All high-voltage control devices are protected inside steel wall compartments with access doors which cannot be opened until the pantograph is locked down and grounded. It is not possible to raise the pantograph until all doors are closed and locked.

Auxiliary Equipment Control

The contactors controlling the operation of the auxiliary machines are magnetically operated. Manually operated switches to actuate these contactors are provided at the operating position.

A voltage regulator is provided to maintain the potential of the generator which normally furnishes control, lighting, auxiliary power and battery charging at a constant value.

The auxiliary drive motors are protected by separate high voltage fuses.

Current Collectors

One air-controlled, spring-operated pantograph collector with renewable double-bow wearing shoes is provided.

A manual locking and grounding switch is provided to lock down and ground the pantograph.

Lightning Arrestor

A capacity-type lightning arrestor, connected directly to the pantograph without fusing, is provided.

Motor-Generator-Blower Set

There is one motor-generator-blower set, powered by a 3000 volt, two-pole, single commutator motor with compensating poles. The generator will provide control, lighting and auxiliary power regulated to 75 volts d-c. Motor and exciter armatures are mounted on a single shaft which is carried on two antifriction bearings. A blower wheel is overhung on a shaft extension at one end of the set.

A second motor-blower less generator set is powered by an identical motor.

The blowers provide cleaned air for forced ventilation of the traction motors, M-G set and accelerating resistors.

Storage Battery

Provision is made for a 60 A.H. storage battery to supply lighting and control power when pantograph is lowered. The battery will be lead acid type.

Brake Equipment

Schedule 26L automatic and independent compressed air brakes with safety control and break-in-two protection with automatic sanding features are provided. Reservoir capacity is 50,000 cubic inches.

Brake cylinders are supported by the truck frames and operate fully equalized brake rigging, which applies two cast iron brake shoes to each wheel. Brake rigging is furnished with hardened steel bushings, and adjustment is provided to compensate for wheel and shoe wear.

Air Compressors

Two Westinghouse Air Brake Company Type 3CDC air compressors, each having a displacement of 120 cfm against a pressure of 140 lb per square inch, are provided.

The compressors are motor-driven. Compressor pumping will be controlled by a governor in the main reservoir supply line.

OPERATOR'S STATION

The operator's station is equipped with:

- (a) One ammeter indicating current in one traction motor armature.
- (b) One voltmeter indicating line potential.
- (c) One voltmeter indicating motor voltage.
- (d) Two duplex pressure gages.
- (e) Wheel-slip warning light.
- (f) Line breaker trip-out indicating light.
- (g) Line breaker reset switch.
- (h) Control and light switches.
- (i) Sander switch, horn and bell control.

Items (a) through (d) are illuminated. Also provided on the back wall of the operator's cab are:

- (a) Control and lighting circuit breakers.
- (b) Pantograph control.

The operator's cab will be equipped with a speed indicating and recording device.

ACCESSORIES

Sanders

Eight, electro-pneumatically operated, arranged to sand ahead of the lead wheels of each truck in each direction.

Horn

One, air-operated, three-bell.

Bell

One, stationary, with air-operated ringer and operating valve.

Extension Lamp Receptacles

In equipment hoods.

Window Wipers

Three, air-operated, mounted on the front of the operator's cab.

Sun Visor

Four, adjustable.

Pantograph Pole

One, fiber glass, protected by a full-length holder along the side of the locomotive platform.

Air Pump

One, hand operated, for raising one pantograph in the event that the pantograph air reservoir is depleted.

Seats

Two, upholstered, and with height, longitudinal travel and 180 degree rotation adjustments. Cushioned arm rests are provided at side windows.

Fire Extinguisher

Two, 20-pound dry chemical, one at each end of the locomotive.

Interior Lights

Electric, for illuminating the operating cab and hoods.

Headlights

Electric, at each end of the locomotive, each consisting of two 200-watt, 30-volt, sealed-beam lamps. Dimming control is provided.

Marker Lights

Two, three-aspect electric lights at each end of the locomotive.

MODIFICATIONS

The following modifications may increase locomotive weight, dimensions, and price:

Automatic Sanding

In addition to manually operated valve, sanding in either direction, automatically initiated in event of emergency brake application.

Awnings

Metal awning over window on each side of operator's cab.

Battery Charging Ammeter

Mounted on wall of operator's cab.

Battery Charging Receptacle

One 150 ampere receptacle for external battery charging.

Break-in-Two Protection

To prevent the possible release of brakes from an emergency application initiated in the train with the brake valve handle in its release position.

Cab Signal Equipment

Train control cab signal or train speed control equipment as now used on various railroads.

Clothes Locker

Located in the operator's cab.

Coupler

AAR Type "F" Coupler in place of type "E". M-380 draft gear required.

Deluxe Cab Seats

Upholstered cab seats with armrests.

Draft Gear

M-380 equipment in place of basic M-381 draft gear.

Regenerative Braking

Equipment for braking the locomotive electrically, using the traction motors as generators and returning power to the catenary. Interlock is included to prevent application of air brakes on the locomotive while in regenerative braking when automatic air is applied to the train.

Extra Cab Seat

Third seat in operator's cab.

Fire Extinguisher

To meet customer's requirements.

Safety Control

Safety deadman control including foot pedal valve, time delay, warning whistle and service brake application.

Sanding Control

Pneumatic instead of electric control for multiple-unit control of manual sanding.

Toilet

Electric incinerating type, dry type or a flush type with water tank and protection against freezing can be furnished.

Tool Box

Can be provided.

Train Communication

Train communication equipment as now used by various railroads.

Water Cooler

Floor-mounted in operator's cab.

Wheel Slip Suppression

Air brake suppression of wheel slips by light application of locomotive brakes.

Windshield Wings

Wind deflectors; one in front and rear of each side window.

Pantograph

A second pantograph can be supplied.